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Quantico, VA 22134-5068*

MASTER OF MILITARY STUDIES

TITLE:

**BRIDGING THE GAP:
EXTENDING THE LIFE OF MARINE CORPS F/A-18 HORNETS**

**SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES**

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EXECUTIVE SUMMARY

Title: BRIDGING THE GAP: EXTENDING THE LIFE OF MARINE CORPS F/A-18 HORNETS

Author: Major James Cooper, United States Marine Corps

Thesis: How does the Marine Corps plan on extending the life of the F/A-18 Hornet to bridge the gap until the initial operational capability of and transition to the F-35B Joint Strike Fighter?

Discussion: Initial Operational Capability for the F-35B, the Short Takeoff Vertical Landing variant of the Joint Strike Fighter, has been repeatedly delayed. In January 2011, the Defense Secretary placed the program on probation and moved the F-35B to the third priority behind the F-35A and F-35C. Due to the original expected IOC of the F-35B, an alternate aircraft was not procured to bridge the gap, as the cost to benefit was not practical. The Marine Corps Fleet of legacy F/A-18 Hornets must be able to continue to maintain operational capabilities to support mission requirements to bridge the gap until the IOC and transition to the F-35B Lightning II.

The question lies in physically extending the acceptable flight hour limitations of aging airframes. Options such as reducing hours flown by each airframe, increasing reliance on simulator training vice flight events, or reducing or removing mission sets from the Hornet community are highly charged issues, and are currently not the solutions being sought by the service. Rather, Naval Air Systems Command is initiating a program of inspections and modifications that will extend the current flight hour restrictions to 10,000 flight hours. This measure is the latest in a series of Service Life Extension measures that have included center barrel replacements to increase Fatigue Life Expended restrictions, hour restriction extensions from 6,000 to 8,000 hours, and inspection programs to increase the allowable hour limitations to 8,600 hours. Further, a new form of tracking aircraft usage and more accurately projecting future usage is currently being designed. This Integrated Master Plan tracking program could allow for the most appropriate shifting of individual airframes between units and between the Navy and Marine Corps to maximize the usage of each individual airframe.

The unknown remains of utmost significance. It is not yet known if the Integrated Master Plan tracking system will be able to identify ways to maximize individual airframe usage so that legacy Hornets will be able to maintain operational capabilities with no degradations. The 10,000 hour modification and inspection program is not yet operational. The process itself will be costly in terms of dollars in time, and it is not known what will be found during the process, or what structural issues may be yet discovered that may result in unforeseen and unacceptable delays with the program. Furthermore, there is not yet a stated date for F-35B IOC. Until a date is known, and industry stakeholders maintain accountability to that date, accurate calculations concerning the current fleet of legacy Hornets cannot be made.

Conclusion: The organization must begin to make preparations and alternate plans to be prepared for a worst-case scenario. Too many variables currently exist to not start looking at

alternate measures. It is unknown if the 10,000 hour SLEP program will encounter unforeseen problems that could reduce the throughput of aircraft needing hours extensions to unacceptable levels. Further, there is not an actual date for transition to the F-35B at this time. Too many things need to go right with too many unknowns. The recommendation is not for panic, but for preparedness. The service needs to begin the process of examining reductions in mission sets, substituting simulator events for flight events, and changing the Training and Readiness Manual to reflect a greater reliance on simulators. These preparations should be taken while pressing forward with the 10,000 hour Service Life Extension Program and implementation of the Integrated Master Tool program.

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THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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The accuracy and depth of knowledge of this paper are the direct result of resident expertise and experience of the individuals interviewed. Speaking with the men currently working on and solving this issue and who have had personal experience in command of squadrons while dealing with service life management issues has been invaluable. I would be remiss in not highlighting that each one of these individuals could have justifiably declined interviews or assistance due to their workloads. Each provided their time and assistance with enthusiasm for assisting me in my efforts. Among the experts who assisted, provided personal interviews, telephonic interviews, dedicated their time, and helped make this paper a better work are Colonel "Crusoe" Robinson, Lieutenant Colonel "Troll" Klassa, Major "Oedi" Glover, and Mr. JP Nolan of MAG-31; Mr. "Rowdy" Siders and Major "Petie" Schenk of Headquarters Marine Corps Aviation; Major "Freeze" Hingley USAF of the Air Force Fighter Requirements Office; Mr. Rick DeVore and Lieutenant Colonel "Mo" Allee of PMA-265 at Naval Air Systems Command; Lieutenant Colonel "Felix" Juenger of the CNAL/CNAP Class Desk; and Mr. Jim "Red Dog" Collins, Colonel "Moon" Mullin, Lieutenant Colonel "Wiz" Mayer, Lieutenant Colonel "Norm" Bates, and Major "Spicoli" Hipp.

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Table of Contents

Page

DISCLAIMER.....	i
ACKNOWLEDGMENTS	ii
I. INTRODUCTION	1
II. BACKGROUND	4
SERVICE LIFE EXTENSION - AN INTRODUCTION	4
WHY EXTEND THE LIFE OF AN OLD AIRCRAFT?	4
III. THE JOINT STRIKE FIGHTER AND MARINE CORPS DECISIONS.....	6
IS STOVL REALLY NECESSARY? RATIONALE FOR A SINGLE T/M/S.....	6
THE JOINT STRIKE FIGHTER: A REVIEW OF PERTINENT CHANGES	8
EFFECT ON MARINE CORPS PLANS.....	9
THE F-35C	10
WHY NOT THE SUPER HORNET?	11
IV. NAVAL AVIATION ACTIONS	13
INITIAL SERVICE LIFE MANAGEMENT AND EXTENSION MEASURES	13
EVOLUTION OF SERVICE LIFE MANAGEMENT MEASURES.....	16
NAVAIR	17
TO GET TO 10,000 FLIGHT HOURS	18
EFFECTS ON THE HORNET COMMUNITY AND AN INTEGRATED MASTER PLAN.....	20
ADDITIONAL HORNETS TO THE MARINE CORPS POOL?	22
SQUADRON TRAINING AND READINESS	22

CONTEMPORARY PROBLEM: F-16 SLEP	23
V. CONCLUSIONS	25
AN UNEXPECTED BENEFIT	25
RECOMMENDATIONS.....	25
ENDNOTES.....	31
APPENDIX A	
GLOSSARY	
BIBLIOGRAPHY	

I. Introduction

On 6 January 2011, Secretary of Defense Robert Gates delivered a briefing that outlined defense-spending reductions. Within that briefing, the government reduced the planned procurement of F-35 Lightning II aircraft, also known as the Joint Strike Fighter, by 124 over the next five years.¹ More importantly for the Marine Corps, the F-35B Short Takeoff Vertical Landing (STOVL) variant of the Joint Strike Fighter (JSF) was placed on a two-year probation with the threat of program cancellation if testing problems are not rectified and was moved from the first priority to the third priority behind both the F-35A and the F-35C.² Previous delays in the F-35B program coupled with these recent developments have created a situation where the current fleet of Marine Corps F/A-18 Hornets must stay in service much longer than originally anticipated. The foremost issue for Marine Aviation is how the Marine Corps intends to extend the life of its aging fleet of legacy F/A-18 Hornets in the face of further delays in F-35B development. A further question is how the service will be able to maintain operational capabilities as this fighter gap continues to widen.

The possible repercussions of further delay of the F-35B are significant. If the flight life of the current inventory of F/A-18 Hornets is to be extended, it may be only a matter of money, inspections, and engineering efforts. However, if extending the flight life of the current inventory of F/A-18s becomes more time consuming, more expensive, or more difficult than anticipated, the service may face a capabilities gap in some measure. If the F-35B program is canceled in total as threatened, Hornet flight life extension will assume a more pressing relevance.

When faced with a prospective capabilities gap, examination must be made of what actions need to happen or what sacrifices need to be made to extend the life of existing airframes. A possibility is the reduction in individual aircraft flight hours. But there are costs associated in reducing flight hours, such as degraded overall aviator proficiency and readiness. Another possibility is a cultural change in the way flights and training are conducted. The service may be forced to remove F/A-18 mission sets entirely to ensure that proficiency can be maintained in certain competencies while forced to reduce overall flight hours. This action is also carries risk. Reflecting the nascent F-35 training paradigm, the service may need to transition to a higher percentage of simulators, which are continually becoming more tactically relevant, in its training regimen. A more extreme possibility to prevent a capabilities gap is the procurement of new aircraft, namely F/A-18E/F Super Hornets, as an option for airframe replacement. However, the possibility remains for funding, engineering efforts, and a new outlook on tracking and maneuvering individual Hornets between the Navy and Marine Corps - and between squadrons – to keep the legacy Hornets flying and able to meet operational commitments with no degradations.

A gap between the planned flight life of the Hornet and the initial operational capability (IOC) of the F-35B Joint Strike Fighter is already a reality. Delays in F-35B testing and evaluation continue to increase that gap. This paper will explore how the Marine Corps is responding to this widening gap and will detail ongoing and future plans to keep the legacy F/A-18 Hornets flying and able to meet operational needs until transition to the F-35B.

Also discussed herein are the background and nature of and Service Life Extension programs, with examples highlighted to build context. Marine Corps decisions in regard to

replacement of the F/A-18 and the decisions to procure only one Type/Model/Series of the JSF, namely, the F-35B STOVL variant, will be detailed and explained. A brief overview of the history of the JSF will be provided to highlight the major program changes and any changes in plans that have resulted from changes in JSF IOC timelines. With the proper base of knowledge built, the examination will transition to the heart of the matter for this particular study – the Service Life Management and Service Life Extension Programs that seek to extend the life of the legacy Hornet, repercussions associated with this Service Life Extension and possible repercussions and requirements and options for the future.

II. Background

Service Life Management refers to the measures and procedures undertaken to mitigate undue aging, wear, and stress to equipment. Service Life Extension describes the measures and procedures undertaken to extend usable life and may refer to a wide range of military equipment, from Landing Craft Air Cushioned to ships to aircraft. These measures may consist of modernization or structural intervention and may include corrective measures such as avionics upgrades, basic part replacement or large scale part replacement due to mechanical fatigue. Replacements and extension programs may be preferred in some cases, as the cost associated with procuring a new aircraft may be significantly greater than the cost of making improvements to existing equipment. Although upgrades may be the only economically viable option for some systems, the cost of upgrading may warrant the replacement option.

Why Extend the Life of an Old Aircraft?

There are myriad reasons why it may be desirable to extend the usable life of an airframe. In some cases, a nation may not have the funds to buy replacement aircraft. In this case, periodic modifications and improvements to upgrade the capabilities of the existing airframe are more economically viable. In other cases, one may possess an aircraft that will perform perfectly well for an extended period by simply making minor modifications. In the case of the United States Department of Defense, the Joint Strike Fighter has long been on the horizon and was initially planned with specific target years for IOC of the individual models. Accordingly, the Marine Corps along with the Navy and the Air Force have planned replacement of legacy aircraft with the planned fielding of the JSF. As the timeline for initial operational

capability of the JSF has moved further away from its initial target date, the services have chosen to both purchase new aircraft and extend the life of the legacy aircraft to bridge the gap until the JSF arrives.

Extension of aircraft is neither a new nor a uniquely American concept, although there exists a robust history of airframe extension within the American military. The Indian Air Force initially procured MiG-21 aircraft in the 1960s and still fly modified variants of the airframe in the form of the MiG-21 Bison. The B-52, whose prototype model first flew in 1952, has undergone a structural Service Life Extension Program on current model airframes that is expected to see the aircraft into the 2040s.³ Over the course of the last decade, the Navy and Marine Corps invested hundreds of millions of dollars in upgrades and reliability improvement programs to extend the life of the aged CH-46 helicopter fleet.⁴

Of interest as a parallel of the F/A-18, the Air Force is proceeding with an F-16 Service Life Extension Program that is directly linked to the continuing delays in delivery of the Joint Strike Fighter.⁵ The F-16C/D, like the legacy F/A-18A/C/D, must continue to bridge the gap for the Air Force until the arrival of the transition to the JSF as the Hornet must bridge the gap for the Marine Corps. Service Life Extensions are not just for the old. The Air Force is already preparing for and contemplating some future issues in regard to extending the life of the F-22 Raptor, expecting such measures to be required as soon as the early 2020s.⁶

III. The Joint Strike Fighter and Marine Corps Decisions

The Marine Corps is faced with a widening gap between the originally anticipated beginning of JSF transition and the actual transition from legacy Hornets. The questions of repercussions of life extensions, and if it is even practical or possible, will be discussed later. Before discussing ongoing and future plans for extending the life of legacy Hornets, some background information will be provided to explain the Marine Corps' decision to pursue just one Type/Model/Series F-35 and why another option – the F/A-18E/F Super Hornet – has not been pursued to bridge the gap.

Is STOVL Really Necessary? Rationale for a Single Type/Model/Series

More important than this sort of expeditionary engineering success is the end result: more aircraft in the air. Sortie generation yields speed, shock and tempo, allowing us to respond to our ground forces in minutes, and to take the fight to the enemy. This is the endstate of what STOVL visionaries foresaw thirty years ago, and Marines are alive today because Marine aviation is up forward, living hard and in the fight side by side with our ground forces.

- The Deputy Commandant for Aviation in the 2011 *Marine Aviation Plan*⁷

As of January 2011, the Marine Corps had planned to procure only one type of JSF – the F-35B STOVL variant. This single type/model/series policy had been the official position for several years. A 2010 brief developed by Headquarters Marine Corps Aviation, Aviation Plans and Policies provides excellent insight concerning the rationale for the STOVL JSF. The rationale is centered about the Marine Corps' amphibious capability, desire to maximize expeditionary capabilities, and ability to most appropriately integrate into the Marine Air Ground Task Force

(MAGTF). The individual rationales will be highlighted briefly to provide a lens into the decision making inside the Pentagon.

An aircraft capable of short takeoffs and vertical landings provides more basing options both ashore and afloat. The world has over twenty times the number of 3,000-foot runways as 10,000-foot or larger runways and five times as many 6,000-foot or larger runways than 10,000-foot runways.⁸ A 6,000-foot runway is an accepted minimum distance an F/A-18 needs for landing and stopping without the aid of arresting gear, whereas a STOVL aircraft can launch and recover to a location as small as an amphibious ship without the need for a catapult launch or arrested recovery. The point of available runways is particularly pertinent to the Marine Corps, whose *Vision and Strategy 2025* document focuses on the organization's capabilities to operate from austere environments, to sustain forward operations, to operate in the littorals, and to remain an expeditionary naval force.⁹

The service has put a premium on the ability to sea-base by way of an amphibious fleet. This is in keeping with the requirements to remain a naval expeditionary force and has the benefit of reducing host nation support requirements, which may vary greatly due to capabilities and political climate. If local airfields are unavailable, the capability of amphibious ship operations offer increased sortie generation rates in comparison to land based aircraft that must travel from a suitable base of operations outside of the local area. Further, the STOVL capability removes the requirement for catapults and arresting gear, which results in twice as many available platforms in the form of the amphibious fleet than aircraft carriers alone.¹⁰

The Headquarters Marine Corps Aviation outlook heavily leverages the capability to forward-base while maintaining the integrity of the Marine Air Ground Task Force (MAGTF).

Forward basing allows for increased sortie rates and decreased transit time, which equals more time on station and less fuel used for transit, more rapid response as a result of trading range for time, flexible basing as a force protection measure, and greater potential for being co-located or quite near the MAGTF ground combat element.¹¹ An additional point exists in the nature of replacing the Marine Expeditionary Unit (MEU) fixed wing capability, traditionally the AV-8B, with the F-35B: it increases the capabilities of the entire MEU or Amphibious Ready Group (ARG) with more robust air-to-air and self-defense capabilities.¹²

The Joint Strike Fighter: A Review of Pertinent Changes

In October 2001, the Development Acquisition Plan Baseline listed the Marine Corps initial operational capability as having an objective date of April 2010.¹³ IOC for the Marine F-35B JSF, as defined by the Marine Corps Deputy Commandant for Aviation, includes a 10 F-35B squadron manned with trained and certified personnel, capable of conducting amphibious operations and TACAIR directed mission sets, able to deploy to expeditionary sites, with the appropriate infrastructure to support home and deployed operations.¹⁴ The Acquisition Plan Baseline Change 1 of March 2004 moved the Marine IOC date to March 2010.¹⁵ As the program developed, changes to the timeline developed. Performance and schedule changes as reported by the December 2003 F-35 Lightning Program Office's Selected Acquisition Report included the delay of system development and demonstration (SDD) first flight, the one year delay of low rate initial production, and the overall delay of initial operating capabilities.¹⁶

The first STOVL flights, test aircraft BF-1 and BF-2, flew in June 2008 and February 2009, respectively, which constituted a delay from the original planned target dates for STOVL test

flights.¹⁷ By August 2008, Marine Corps F-35B Initial Operational Capability was planned for 2012 according to the Joint Strike Fighter Operational Requirements Document, Change 3 of August 19, 2008.¹⁸

The 2009 Selected Acquisition Report noted the delay of the first CV variant flight, the delay of the first production aircraft delivery, and a delay in completion of Initial Operational Test and Evaluation (IOT&E).¹⁹ The F-35 Lighting Program Office's *Selected Acquisition Report* of December 2009 reported that the IOC of the Marine variant F-35B was indeed on its updated schedule for 2012.²⁰ Both the Navy and Air Force IOC were planned for 2016 at this time.

Effect on Marine Corps Plans

The changing dates of planned IOC have been of concern to the Navy, the Air Force and the Marine Corps in particular. As of the last months of 2010, some of the more significant problems in testing of the JSF have been issues resulting from the complexity of the systems associated with only the STOVL variant. These issues were partly the cause of the recent F-35B probation. Prior to 2007, the Marine Corps planned to transition the aging AV-8B fleet to the F-35B prior to transitioning the F/A-18s.²¹ However, by 2008, as the JSF program was delayed and Hornet service life became an issue, the plan was changed. Currently, there is a more integrated plan to replace Hornet and Harrier squadrons in more of an alternating manner than one airframe before the other. While the Harrier will not face structural fatigue problems over time as the Hornet is facing due to differences in airframe engineering, a critical consideration for transitioning the AV-8B exists in parts obsolescence – the longer the airframe is flown, the more difficult and costly it is to procure parts.²²

Prior to Secretary Gates' announcement of 6 January 2011, the Marine Corps had planned to stand up its first operational F-35B squadron during calendar year 2012. The remaining Marine F/A-18 squadrons would transition in ones and twos through the early 2020s.²³ The 2012 gate for IOC will not be met. Once the F-35B program reaches the stage where aircraft are ready to be delivered to the Marine Corps, the Fleet Replacement Squadron still must train the aviators before transition to the fleet squadrons – with additional time required to meet the stated requirements for IOC. These plans will continue to evolve as the F-35B IOC timeline continues to shift.

The Commandant of the Marine Corps issued a statement on 10 January 2011 to address the Defense Secretary's recent announcement. The Marine Corps' official position is not one of panic, but identifies that development issues should indeed be closely monitored and corrected. In the statement, General Amos states, "Secretary Gates has given industry and the government two years to get the F-35B variant back on track; I am confident this can be accomplished. Over the course of the next two years, I expect the Joint Strike Fighter Program Office, Lockheed Martin, Pratt and Whitney, and the multitude of stakeholders directly involved in the development and production of the F-35B to meet and exceed our requirements."²⁴

The F-35C

On 14 March 2011, the Commandant of the Marine Corps Signed a memorandum of understanding along with the Chief of Naval Operations and the Secretary of the Navy stating that the Marine Corps would procure 80 F-35C Naval variant in addition to 340 F-35B STOVL variant JSFs.²⁵ These Marine F-35C aircraft will be integrated into aircraft carrier air wings as part of the TacAir Integration Plan.²⁶ The relatively low number of 80 F-35C aircraft and the tie-

in to the TacAir Integration Plan demonstrates that while the commitment to transitioning a vast majority of Marine fixed-wing tactical aircraft to the F-35B remains, something had to be done to begin the process of transitioning to the JSF while the F-35B program is correcting deficiencies as mandated by the Secretary of Defense.

Ultimately, the Secretary of Defense's January 2011 statement and December 2010 resource management decision facilitated the decision to procure the F-35C variant.²⁷ Those resource management funding decisions impacted the planned number of aircraft that could be procured per year, which in turn has repercussions on each successive year in the planned transition, resulting in a longer process overall.²⁸

It is speculative to hypothesize that the Marine Corps would have chosen another option had the initial F-35B IOC date been 2015 vice 2010. Perhaps different decisions would have been made in terms of procurement of another airframe, but hypotheticals are irrelevant.

Why Not the Super Hornet?

An information paper originating from Headquarters Marine Corps, Aviation from May 2007 provides the service's rationale concerning the decision to not procure Super Hornets to bridge the gap between the legacy Hornet and the JSF. The F/A-18E/F is discussed as simply an improved (in some respects) legacy Hornet. In 2007, the promise of the more advanced JSF and its near arrival was worth waiting for vice all the cost and effort that goes into procuring another aircraft that is not better in many respects than the legacy Hornet. Further, and of some topical pertinence, the F/A-18E/F program is anticipating shortfalls in the 2020s and is already known to require its own life extension programs.²⁹

A further rationale is cost. The F-35B costs approximately 113 million dollars per aircraft. The F/A-18E/F costs approximately 83 million dollars per aircraft, plus the cost of new support equipment and training, plus the additional costs associated with two required service life extension program inspections per aircraft.³⁰ The dollar value is a significant factor considering how few years remain before planned JSF transition. Overall, procuring another airframe was viewed as not worth the cost and effort given the planned IOC of the F-35B.

IV. Naval Aviation Actions

Service Life Extension has been described, background has been provided via a brief recap of the JSF program and its unplanned delays, and context established in regard to Marine Corps decisions that have led to the current situation and necessary measures to prevent it. Now those measures will be examined to determine how the life of the legacy Hornet has been extended to date, and how it will be extended further.

The questions have been posed herein in regard to reducing mission sets, changing the way training is conducted, or changing culture entirely with the aim of reducing flight hours, which would by its nature extend the amount of years the airframe can operate. The past and current answer lies not in reducing capabilities, but in engineering. Plans for taking mechanical measures to extend the life of the airframe began a decade ago, have continued throughout the first decade of the 21st Century, and have recently been reevaluated to provide costly but necessary measures to keep the legacy Hornet flying.

Initial Service Life Management and Extension Measures

In the past, newer aircraft replaced older aircraft before we had to consider the life of the airframe. This is no longer the case: we must manage our airframes (sic) service life as efficiently as possible.³¹

- 2004 Service Life Management Program Message

The Navy and Marine Corps began planning Service Life Extension measures for the F/A-18Cs and Ds a full decade ago. A 2001 statement estimated that 355 legacy Hornets would require a life extension to meet demand until 2020.³² At that time, the Service Life Extension measure of primary concern for extending the airframe's useful life was the replacement of the aircraft's center barrel. This process began in 1999.

The Center Barrel Replacement Plus (CBR+) modification is a process by which the aircraft is taken apart in order to remove and replace the central load bearing part of the aircraft, which will extend the service life of the aircraft significantly.³³ The center barrel is centrally located within the airframe, where the main landing gear and wings attach to the aircraft. Replacing the part is a time consuming and costly process - costing approximately 2.5 million dollars per aircraft.³⁴ The fix is for aircraft approaching the end of usable wing root fatigue life expended, which is an engineering metric that measures aggregate material stress around certain parts of the airframe. The CBR+ program is expected to continue through 2016.³⁵

The process of extending the flight life of the Hornet through specific processes at the squadron level can be traced to 27 June 2004 with the introduction of the Service Life Management Program from the Commander Naval Air Forces (CNAF) and the Deputy Commandant for Aviation (DC/Air) via naval message. The Service Life Management Program detailed in this message provided guidance to F/A-18 leadership and aircrew in the handling of operational and maintenance issues that could affect the wing root fatigue life and methods of tracking it accurately, along with attempting to explain the nature of the problem facing the Hornet community.³⁶

The three most critical measures in Service Life Management were defined as total spectrum flight hours, landings (including arrested landings), and fatigue life.³⁷ Spectrum flight hour is simply a term indicating that some flight regimes are more demanding on the airframe than others; all flight hours are not created equal. Fatigue life of the aircraft is used for engineering purposes, measuring structural fatigue at different points of the aircraft with the

wing root being the area of greatest importance.³⁸ Wing root fatigue life expended, commonly expressed as FLE, is what is corrected with the center barrel replacement procedure.

The design limits for the F/A-18A through D, as of June 2004, were 6000 spectrum flight hours, 8300 landings, and a wing root fatigue life extended of 1.0, with an additional restriction of 0.78 wing root fatigue life extended on pre Lot 18 aircraft.³⁹ Appendix A contains the table contained in the June 2004 message and depicts the primary initial priorities of service life limiters for F/A-18Cs and F/A-18Ds, which were catapults/arrested landings (cat/trap) and FLE, respectively.⁴⁰

The initiatives instituted by this message were directed toward engineering and repair, flight operations and maintenance procedures. The engineering and repair initiatives included the CBR+ Program to restore wing root fatigue life or extend cat/trap limits and a Service Life Assessment Plan (SLAP) to increase the allowable cat/trap limits.⁴¹

The onus was placed on squadron commanders to manage consumption of service life. These measures included improved maintenance tracking so that FLE was able to be recorded more accurately, and the limiting of the types of sorties, maneuvers and flight regimes that result in high fatigue life expenditure beyond that which was required to maintain readiness and proficiency as directed by the Training and Readiness (T&R) manual.⁴² A brief examination of the table in Appendix A coupled with the measures directed by the message show that the focus of effort in prolonging life of the aircraft was centered primarily on fatigue life expended.

Evolution of Service Life Management Measures

A subsequent Service Life Management Program message was released in October 2007. A service life bulletin, SLB 008, published between these two messages had granted an

interim flight clearance to 8000 hours for the F/A-18 for aircraft with remaining fatigue life.⁴³ SLB 008 also increased the acceptable number of landing to 14,500 for F/A-18A-C and 17,000 for F/A-18D aircraft (with further details for CV and bolters). These extensions were a result of Naval Air Systems Command's (NAVAIR) Service Life Assessment Program, Phase I, which developed recurring inspections and criteria to allow for the life extensions.⁴⁴ Through engineering reviews, the limits for landings and acceptable flight hours were extended. Further, a new service life limiter matrix was published, which can be found in Appendix A. Of significance is that despite the increase in allowable flight hours, total hours had now become the primary concern for F/A-18Cs.⁴⁵

A factor that bears mention is the flight hour strain of operations in support of Operation Iraqi Freedom after 2003. Marine F/A-18s, and D model Hornets in particular, began to fly more flight hours at a more rapid rate than would otherwise have been flown. These operational deployments increased the rapidity with which the airframes in use approached the flight hour limit for the aircraft.

A third F/A-18 Service Life Management Program message was released in January of 2009 to provide a program update. This message provided no new guidance to commanders but did announce the development of tools to be used by squadrons to track SLMP data by Bureau Number (BUNO) at the squadron level for executive level tracking.⁴⁶

NAVAIR

We acquire, deliver, and sustain the F/A-18 weapon system with capabilities that optimize its contribution to the end user's mission.

- PMA-265 Mission Statement

PMA-265, an office within NAVAIR, is the Program Management Office for the F/A-18 responsible for Service Life Extension of the Hornet.

As legacy Hornets continued to fly with no change to training requirements or hours requirements and the F-35B continued to move further away from planned IOC, the flight hour limitation on the legacy Hornet became an issue that required immediate attention. Across the Naval inventory, as of December 2010, 67% of legacy F/A-18s had accumulated over 6000 flight hours.⁴⁷ Had the flight clearance to 8000 flight hours not been approved and no other action taken, two thirds of the current legacy Hornet fleet would no longer be available today. Further, based on an estimate of each aircraft flying 330 hours per year, it is plain to see that an extension of 2000 hours only equals six more years of available flight at current rates.

After concluding Phase 1 of their Service Life Assessment Program, NAVAIR began Phase 2 in 2005 and concluded it in 2008. During this second phase, total landing limits for two-seat F/A-18s were re-evaluated in order to further extend the allowable landings and a cost model was developed to assess cost in achieving the goal of 10,000 flight hours for the legacy Hornet.⁴⁸ That analysis revealed that a 10,000 flight hour goal was “not achievable without additional funding to support extensive inspections and modifications.”⁴⁹

To Get to 10,000 Flight Hours

Extending the flight hour limitation from 8,000 to 10,000 hours will not simply be a matter of inspections. It will require modifications as well.⁵⁰ The process itself is not yet authorized, but is currently being devised by PMA-265. Thus far, hundreds of individual areas known as critical locations on the F/A-18 have been examined to determine if the individual

areas would last until 10,000 flight hours or would need inspection and/or replacement at some point before 10,000 hours.

An interim measure that has been developed by NAVAIR is the High Flight Hour (HFH) Inspection, which had its origins as far back as 2004.⁵¹ This inspection increases the amount of available flight hours by 600 hours from the time at which the aircraft was inspected. Therefore, if an aircraft is at its flight life limit of 8000 hours and successfully completes the inspection, it will now have a flight life limit of 8600 hours.⁵² These inspections can be performed at the Naval Air Station North Island Depot or by Depot personnel at satellite locations, such as current Hornet bases.⁵³ Issues which must be noted in regard to available Hornets for the Navy and Marines are the amount of aircraft that will require this High Flight Hour inspection and the amount of time required to complete the inspection. 43 aircraft are planned to undergo the inspections in 2011 and 71 aircraft in 2012.⁵⁴ The historic turnaround time for completion of each individual aircraft inspection is 451 days.⁵⁵

Currently, analysis is being conducted to determine the recurrence intervals of certain inspections and fatigue tracking algorithms and tools are being developed.⁵⁶ The next phase, which is expected to begin in the spring of 2011, will design and develop structural modifications, procure kits, establish facilities, and begin aircraft structural modifications with the goal of ensuring core aircraft can get to 10,000 hours.⁵⁷

As of December, 2010, there were 634 F/A-18 A through D aircraft in the Naval inventory.⁵⁸ 150 of those aircraft are currently planned for the 10,000 hour Service Life Extension modifications and inspections.⁵⁹ The SLEP program is scheduled to last from 2012 to 2018, with anticipated annual budgets for SLEP for the next five years as follows: 250 million

dollars in FY2012, 300 million dollars in FY2013, 450 million dollars in FY2014, 350 million dollars in FY2015 and 250 million dollars in FY2016.⁶⁰

These numbers reflect several things; startup of the potential lines at the Depot (where inspections and modifications will occur), peak operations around FY2014, and the winding down of the program as some aircraft retire and some achieve the required extension to last until the last planned JSF transition in 2023.

Marine Aircraft Group-31 (MAG-31) is the lead Type/Model/Series for F/A-18 life extension issues within the Marine Corps. The MAG-31 Commanding Officer, Col D. A. Robinson voiced concern not with the potential SLEP process, but what is yet unknown and what else might be found in the midst of these inspections.⁶¹ PMA-265 acknowledges Colonel Robinson's concern, recognizing that the discovery of unpredicted damage during inspections is indeed a possibility.⁶²

Of further concern is the question of how long these 10,000 flight hour inspections and modifications will take, which may be dependent on what is found during the course of the individual inspections that was not expected. Funding to PMA-265, engineering legwork and a thorough examination of what needs to be done to get the aircraft to 10,000 hours has yielded a plan that is achievable at the cost of significant time and money. The concern to be highlighted is the question of issues with individual aircraft that may arise during the process of the inspections and modifications.

Effects on the Hornet Community and an Integrated Master Plan

A plan is being formulated for the extension of the aircraft's life to 10,000 hours. What now must be examined is what the Marine Hornet community currently doing to ensure the longevity of the airframe while maintaining operational commitments and capabilities. Is it a matter of reducing flight hours for aircraft and aviators, or increasing simulators, or does the answer lie in reducing mission sets? The answer, surprisingly, is none of the above – at least not yet.

MAG – 31, located at Marine Corps Air Station (MCAS) Beaufort, South Carolina, is the lead MAG concerning F/A-18 life extension issues. Within the last two years, the concept for an Integrated Master Plan to more holistically look at aircraft usage was born. This concept has been pushed by MAG-31 leadership. Basically, while the Hornet community was tracking fatigue life expenditure, cats, traps, and landings to ensure the life of the aircraft, it became more apparent over time that the nearest threat was actually the flight hour limitation.⁶³ Thus was born the requirement for the Integrated Master Plan, which will be a tracking tool that more accurately tracks information pertaining to expenditure of flight life with the intent of reducing the heretofore supposed flight life expenditure. The tool, which is currently contracted through NAVAIR and being developed, will take different factor sets into account and track each airplane in the inventory.⁶⁴

The new ability to track aircraft information available will enable a more accurate understanding of precisely what resources, in terms of hours and airframes, are available. The Commander Naval Air Force Atlantic / Commander Naval Air Force Pacific (CNAL/CNAP) F/A-18 Class Desk manage the placement of all Navy and Marine Corps F/A-18s. The Integrated Master

Plan will help augment the way in which the Class Desk assigns aircraft due to the Integrated Master Plan tool's proposed capability to project future aircraft usage.⁶⁵ The current inventory forecasting tool uses only past history, which can lead to erroneous projections by making suppositions based on historical data and not future use.⁶⁶ Thus, instead of having to make assumptions based upon past history, the management of the fleet can be accomplished by looking forward and most advantageously placing aircraft to maximize the use of flight hours across all airframes.

The ability to forecast use will not itself solve the issue of flight hours. Colonel Robinson believes that the Navy and Marine Corps will have to mix Lots to successfully bridge the gap until JSF arrival, assuming airframe flight hour extensions to 10,000 hours.⁶⁷ This belief is shared by the CNAL/CNAP Class Desk.⁶⁸ Different Lots of aircraft may have different engines, radars, ejection seats, environmental control systems, fuel systems, flight controls and avionics. Traditionally, squadrons have been comprised of same Lot aircraft to the maximum extent possible. However, in the interest of maximizing the amount of hours on each individual airframe, a higher degree of mixing Lots will become a reality.⁶⁹

Successful extension of the F/A-18's flight life still carries unknown variables. Colonel Robinson believes that the gap cannot be quantified until a thorough Bureau Number (BUNO) by BUNO examination is accomplished.⁷⁰ His belief concerning successful extension of the F/A-18 hinges on three key elements; a sound knowledge of resources in terms of airframes and flight hours available, the actual engineering capacity of the depot, and industry accountability to deliver the F-35B on time.⁷¹

Additional Hornets to the Marine Corps Pool?

Secretary Gates' press briefing announcements of 6 January 2009 placed the F-35B on a two-year probation and raised the possibility of canceling the F-35B program altogether.⁷² However, a subsequent announcement revealed that the Pentagon will procure 41 additional F/A-18 Super Hornets for the Navy over the next three years.⁷³ While no plans have been made as of yet, this could result in Navy F/A-18 squadrons transitioning to Super Hornets, which may allow those legacy Hornets to transition to service with the Marine Corps. This is purely speculative at this point. While the acquisition of additional legacy Hornets from the Navy would not solve all problems in terms of the JSF gap, increasing the pool of legacy Hornets the Marine Corps has access to is significant.

Squadron Training and Readiness

What about reducing flying hours via a reduction in mission sets? To some it may appear as if some mission sets or certain events within mission sets are expendable. The logic being that if forced to reduce annual flying hours, certain missions could be shed so that a number of hours currently required to maintain competency in a skill could remain in place, just with fewer individual missions for which to maintain competency. However, there are also dangers associated with reducing mission sets. An argument is that the service cannot afford to cut missions, as those mission sets are based upon established theater contingency plans.⁷⁴ Further dangers in removing mission sets are the potential for permanent loss of resident knowledge in a particular area and the parochial interest of the service to not willingly reduce capabilities for fear of a permanent loss of capability.

APP-31, TACAIR Plans and Integration is the office within Headquarters Marine Corps Aviation responsible for examining strike-fighter shortfall issues and how those issues will affect the Marine Corps' transition plan. In terms of taking drastic measures concerning the reduction of F/A-18 utilization, APP-31 is not taking any steps before it becomes necessary.⁷⁵

Changes to the Marine Corps T&R Manual to counter possible future issues of reduced aircraft availability or flight hours are not being considered just yet. The most recent T&R revision was published in 2010. The process required approximately three years to complete and did indeed place more emphasis on simulator events.⁷⁶ For now, the MAGs will continue to fly the hours required to train to the standards set forth by the current T&R.

Contemporary Problem: F-16 SLEP

The U.S. Air Force is in a similar position to the Marine Corps due to its core fighter aircraft, F-16Cs and F-16Ds, also requiring a Service Life Management Program to extend their usable life due to airframe hour and fatigue life issues.⁷⁷ Like the Hornet, the F-16 has also accrued hours and fatigue at a rate greater than anticipated due to the current operating environment, and will undergo an extension program to allow certain block aircraft to fly beyond 8,000 hours.⁷⁸ A significant difference exists between the Air Force and Marine Corps situations in that the F-16 production lines are still open and building aircraft for foreign sales, which provides the service with an option the Marine Corps does not have. However, the service currently favors a Service Life Extension Program due to its cost effectiveness vice purchasing new airplanes, although the option to buy new F-16s remains.⁷⁹ While details between the predicaments of the two services vary, the basic nature of the problem is the

same. Air Force sponsored studies, solutions and general shifts in the paradigms of mission sets, flight hours, training can and should be leveraged if applicable.

V. Conclusions

Since the beginning of the F-35 program, a rationale for not procuring another airframe has been the prohibitive cost in comparison with the few years remaining until the JSF was to replace the F/A-18, as previously discussed. This trend has continued throughout the years and throughout the changes to the expected JSF IOC. The F/A-18 SLEP program will be expensive. The expected arrival of the JSF in 2012 would provide an argument against additional funding for a Hornet SLEP program, or at least make the procurement of the funding required to SLEP the necessary number of aircraft difficult. Given Secretary Gates' public statement of 6 January 2011, the need for a fully funded Hornet SLEP program has become all the more viable and tangible, which is an unexpected benefit of the JSF delay.⁸⁰

Recommendations

If we lose the F-35B, there is no Plan B for fixed-wing airplanes on the large deck amphib.

- Commandant of the Marine Corps, Senate Armed
Services Committee March 2011⁸¹

How was the issue with flight hours and long-term life extension not being looked at long ago? While the legacy Hornet was initially designed with the expectation that flight life expended would be the limiting factor and would be reached prior to flight hours becoming a factor, this metric was revisited, resulting in the realization that a flight hour restriction was indeed required.⁸² This restriction of 6,000 spectrum flight hours is reflected in the F-18 Service Life Management Program Naval Message of June 2004. The planned IOC in 2001 for the F-35B was March 2010. Over 60% of F/A-18s currently have over 6000 hours. Without an interim

flight clearance extension to 8000 flight hours, a majority of the Hornet fleet would be beyond the usable airframe life today. The Marine Corps has never intended to buy Super Hornets to bridge the JSF gap.

While the question warrants further discussion, it is outside the scope of this particular work. The fact is that the F-35B has not achieved IOC as initially projected, and will not achieve IOC in 2010 in accordance with the Fiscal Year 2011 Marine Aviation Plan.⁸³ What can be learned from this question is the need to look forward and to be prepared for possible measures to keep the current fleet of legacy Hornets capable of meeting operational needs until a replacement arrives.

Many variables exist at this time. The Integrated Master Plan, to be unveiled in late 2011, is a great step in the right direction and may be a valuable tool to assist in the proactive movement of aircraft, enabling the maximizing of flight hours across the entire fleet of legacy Hornets. That, coupled with mixing of aircraft Lots within squadrons, which is another great step in the right direction, may be enough to see the Hornet fleet through to JSF delivery without requiring fundamental changes.

However, it is still unknown if the SLEP procedures of inspections and modifications will be able to turn around aircraft quickly enough to avoid a degrading of capabilities across the Fleet. The process is being designed currently. While significant dollar amounts have been allotted for the 10,000 hour SLEP program for the next five fiscal years, unforeseen delays could result in unforeseen costs and a reduction in the number of aircraft to receive the inspections and modifications per year – a problem that could compound over time without additional funding and means for throughput.

Further, the factor of the unknown still exists in terms of what else might be found in the midst of these inspections that is not currently planned for. Despite significant efforts to date in identifying parts and areas that will require inspections, NAVAIR cannot know what additional problem spots and surprises will be found during the SLEP inspections, and therefore, how significant the result may be.

The final variable is the IOC and transition of the F-35B. The JSF program will likely continue to have unexpected delays. The entire F-35 fleet was grounded in March 2011 as a result of an in-flight generator failure during a test flight. While this particular emergency did not result in a loss of aircraft, it is reasonable to expect that further unforeseen events such as this will occur before IOC. If the F-35B program is done away with entirely, new options will have to be explored. If the F-35B program continues, hard dates must be established and maintained in order to adequately groom and maneuver the fleet of Hornets to properly last until transition. Without an identified date for IOC – and a date that the parties involved will be mandated to meet – the planning for extending the life of the Hornet must be based partially on optimistic assumptions in regard to F-35B transition.

The organization must begin to make alternate plans and preparations to be ready to react to a worst-case scenario. Too many variables currently exist to not start looking at alternate measures. It is unknown if the 10,000 hour SLEP program will encounter unforeseen problems that could reduce the throughput of aircraft needing hours extensions to unacceptable levels. Further, the transition to the F-35B is an unknown quantity at this time. While the cancellation of the program may not be a likely decision, the option has been verbalized and should be viewed as a possibility. While the prospect of receiving more legacy

Hornets as the Navy procures additional Super Hornets is enticing, it is a mistake to assume the Marine Corps will indeed get those additional airplanes in lieu of preparing for another case. Too many things need to go right with too many unknowns. The recommendation is not for panic, but for preparedness.

The March 2011 Marine Corps decision to procure 80 F-35C variant JSFs was a necessary reaction to recent changing conditions, but it does not solve the overarching issue of transitioning the current Hornet fleet as well as the Harrier fleet. Both airframes will need a transition, the organization is still planning on procuring 340 VSTOL variant JSFs, and neither the F-35C nor the F-35B will be available to meet the transition plan as detailed in the FY11 Marine Aviation Plan. The F-35C procurement is a measure to begin the process of transition of some portion of the force while the F-35B program remains in its probationary period and in third place in terms of JSF priority. Further, it may be the first installment of what eventually may be a more balanced F-35C and F-35B fleet for the Marine Corps, but that remains to be seen.

A change in overall culture will be unnecessary. Senior aviators are intimately familiar with the strains of Service Life Management and Service Life Extension measures. That leadership sets the tone for the subordinates. At this point, junior Hornet aircrew have been brought up with Service Life Management procedures as a way of life. Individuals in positions of squadron leadership have been involved with the processes for some time and should well understand the issues at hand. Continuing with current and increasingly restrictive Service Life Management directives should not result in institutional issues.

Reducing mission sets is seen as a dire measure, which would involve other services providing and being responsible for missions the Marine Corps could traditionally provide on its

own. However, this does not negate that the Marine Corps should be proactive in exploring what mission sets or subsets would be removed, or would be recommended for removal, should it become necessary to reduce the long-term strain on the legacy Hornets.

The organization should prepare itself to fly fewer hours per aircraft per year. Assuming no mission sets are removed, the lost hours in the aircraft should be replaced by additional simulators. This would coincide with a change of the T&R Manual, which would require wide scale vetting at the MAG and squadron level. Given the length of time that thorough T&R revisions require, this option should be examined in the near term to initiate the discussion and thought processes of those in positions to vet the T&R at the very least.

Current F/A-18 simulators are tactically relevant and provide valuable training in many regimes. Current simulators cannot simulate the physical and environmental rigors of flight, nor can they adequately recreate the inherent risk involved or teach the intangible of feel for the airplane. However, time, fuel, and maintenance man-hours are saved, and one can practice the procedures for every system and weapon system, which cannot be done without great difficulty in the jet. The Air Force is already moving toward this paradigm of more simulator events per flight hour due to similar issues with its aging F-16C/D fleet.⁸⁴

Simulator buildings currently operate during business hours, but more funding could allow for more operators and simulator staff personnel to double the effective hours, allowing for much more throughput – allowing the simulators to operate commensurate with the actual daily hours a squadron would fly.⁸⁵

The decision to fund full scale SLEP was necessary and may successfully allow the legacy Hornets to extend their flight life to 10,000 hours while maintaining operational capabilities

until the F-35B can replace it. The Integrated Master Plan tool will be available by October of this year, the planning for the next phase of Service Life Extension is underway, and the F-35B program has been given two years to get back on track. Much remains to be seen concerning whether or not the legacy Hornet will be able to bridge the JSF gap and what changes, if any, will be required. 2011 should reveal many answers for those involved with the legacy Hornet.

¹ Bob Cox, "Defense Secretary Proposes Cutting 124 F-35 Purchases," Fort Worth Star-Telegram, January 7, 2011, <http://ebird.osd.mil/cgi-bin/ebird/displaydata.pl?Requested=/ebfiles/e20110107798690.html> (accessed January 7, 2011).

² Cox.

³ Boeing, "U.S. Air Force Celebrates B-52 Stratofortress Golden Anniversary," http://www.boeing.com/news/releases/2002/q2/nr_020412.htm.

⁴ Otto Kreisher, "Aircraft Geriatrics," *Sea Power*, November 2006, 32. <http://proquest.umi.com>.

⁵ Dave Majumdar, "AF Bomber Plans Hinge on Savings," *Defense News*, January 17, 2011, <http://ebird.osd.mil/cgi-bin/ebird/displaydata.pl?Requested=/ebfiles/e20110116800448.html>.

⁶ John A Tirpak, "End of the Raptor Option?" *Air Force Magazine*, September 2010, 12. <http://proquest.umi.com>.

⁷ Deputy Commandant for Aviation. *FY11 Marine Aviation Plan*. (Headquarters United States Marine Corps, (September 16, 2010).

⁸ Headquarters United States Marine Corps Aviation, APP. *Why STOVL JSF version 7*. PowerPoint Brief. (Headquarters United States Marine Corps, May 2010), 1 - 25.

⁹ Strategic Vision Group, *Marine Corps Vision & Strategy 2025* (United States Marine Corps, 2007). <http://www.quantico.usmc.mil/activities/?Section=SVG> (accessed August 15, 2010).

¹⁰ Headquarters United States Marine Corps Aviation, APP. *Why STOVL JSF version 7*, 1 - 25.

¹¹ Headquarters United States Marine Corps Aviation, APP. *Why STOVL JSF version 7*, 1 - 25.

¹² Headquarters United States Marine Corps Aviation, APP. *Why STOVL JSF version 7*, 1 - 25.

¹³ The Under Secretary of Defense, Acquisition, Technology and Logistics. *F-35 (Joint Strike Fighter) Lightning II Acquisitions Program Baseline Development Estimate Change 2* (Washington, DC: The Under Secretary of Defense, 30 March 2007), B-1.

¹⁴ Deputy Commandant for Aviation. *USMC Initial Operational Capability (IOC) Requirements* (Washington, DC: Headquarters United States Marine Corps, March 1, 2010), 1.

¹⁵ The Under Secretary of Defense, Acquisition, Technology and Logistics.

¹⁶ F-35 Lightning II Program Office, *Selected Acquisition Report, F-35* (Arlington, Virginia: F-35 Lightning II Program Office, December 31, 2009), 29.

¹⁷ F-35 Lightning II Program Office.

¹⁸ Joint Strike Fighter Program Office, *Operational Requirements Document Change Notice 3* (Arlington, Virginia: Joint Strike Fighter Program Office, August 19, 2008).

¹⁹ F-35 Lightning II Program Office.

²⁰ F-35 Lightning II Program Office, 7.

²¹ Mr. Randy Siders, telephone interview with author, January 31, 2011. Mr. Siders works at Headquarters Marine Corps Aviation, APP.

²² Mr. Siders telephone interview.

²³ Deputy Commandant for Aviation. *FY11 Marine Aviation Plan*.

²⁴ Commandant of the Marine Corps, "General James Amos' Statement on the Joint Strike Fighter," January 10, 2011, http://www.marines.mil/unit/hqmc/cmc/Documents/Gen%20Amos'%20Statement%20the%20Joint%20Strike%20Fighter%20110110_s.docx (accessed January 22, 2011).

²⁵ Sergeant Michael S. Cifuentes, "Marine Corps Continues Flying with Joint Strike Fighter

Program," Marines.mil, March 16, 2011, <http://www.marines.mil/unit/hqmc/Pages/MarineCorpscontinuesflyingwithJointStrikeFighterprogram.aspx>.

²⁶ AFP, "US Marine Corps buying 80 F-35C Jets," AFP, March 16, 2011, <http://www.google.com/hostednews/afp/article/ALeqM5iXayDhLlmzvHJYIB1MXqLkImja4A?docId=CNG.c63a5772179f4f ebba0de71869b75793.161>.

²⁷ Major Brian "Petie" Schenk USMC, interview with author, March 16, 2011. Major Schenk is an F/A-18 pilot and currently works at Headquarters Marine Corps Aviation, APP-31 TACAIR Plans and Integration.

²⁸ Major Schenk interview, March 16, 2011.

²⁹ Major T. C. Fries. *Why the USMC does not want F/A-18E/F Information Paper* (Headquarters United States Marine Corps Aviation, APW-21, 1 May 2007).

³⁰ Major C. W. Del Pizzo, *The Marine Corps STOVL Requirement* (Headquarters United States Marine Corps Aviation, APW-22, July 2010).

³¹ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 3.

³² Hunter Keeter, "Navy, Marines Hold Course on SLEP Plan for F/A-18C/Ds," *Defense Daily*, February 21, 2001, <http://proquest.umi.com>.

³³ Fleet Readiness Center Southeast F/A-18 Center Barrel Replacement Plus Program, http://docs.google.com/viewer?a=v&q=cache:zxfNpWUe87wJ:www.shingoprize.org/files/upload/AwardRecipients/SilverMedallion/08-FRCSoutheast.pdf+Center+Barrel+replacement&hl=en&gl=us&pid=bl&srcid=ADGEESgNvY1WYbl9S9dOv_-xIWgGbk1wpeFVLmeYAF3H5opkKrb6gvWBWfOhB6TaBME11dw2vOkRztWHNcE0se6sJLwBJhxVKpEHgfr1w9fVIC1uEXO5eAAck3OKiXrNdWM-J541IH16&sig=AHIEtbTMV6h9YQmRYipyeDZ8QXFKUMYZxg (accessed January 22, 2011).

³⁴ Jim Boone, William F. Conroy III, CAPT Mark Darrah, Rick DeVore, CAPT Fred Hepler, and RADM Mark Skinner, "A Good Idea Comes to Fruition: The F/A-18 Center Barrel Replacement-Plus Program," *Defense AT&L*, September 1, 2010, <http://www.thefreelibrary.com/A+good+idea+comes+to+fruition%3A+the+F%2FA-18+Center+Barrel...-a0240624309> (accessed 22 Jan 2011).

³⁵ PMA-265, *F/A-18 & EA-18G Program SLAP SLEP Overview* PowerPoint Brief (Naval Air Systems Command F/A-18 Program Office, December 2010), 5.

³⁶ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 2.

³⁷ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 3.

³⁸ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 3.

³⁹ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message June 1, 2004), 4.

⁴⁰ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 4.

⁴¹ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 5.

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- ⁴² Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, June 1, 2004), 2 - 3.
- ⁴³ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, October, 2007), 1.
- ⁴⁴ PMA-265, 5.
- ⁴⁵ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program* (Naval Message, October, 2007), 1.
- ⁴⁶ Commander Naval Air Forces and Deputy Commandant for Aviation, *FA-18 Service Life Management Program Update* (Naval Message, January, 2009), 1.
- ⁴⁷ Rick DeVore, interview with author, December 27, 2010. Mr. DeVore is the F/A-18 A-D Air Vehicle IPT Lead at Naval Air Systems Command, PMA-265, the lead engineer involved in F/A-18 Service Life Extension, and led the Center Barrel Replacement innovation process.
- ⁴⁸ PMA-265, 5.
- ⁴⁹ PMA-265, 8.
- ⁵⁰ Rick DeVore interview.
- ⁵¹ PMA-265, 14.
- ⁵² Lieutenant Colonel "Mo" Allee, telephone interview with author, January 26, 2011. Lieutenant Colonel Allee is an F/A-18 pilot currently at NAVAIR F/A-18 A-D Air Vehicle IPT at PMA 265 along with Mr. DeVore.
- ⁵³ Lieutenant Colonel Allee interview January 26, 2011.
- ⁵⁴ PMA-265, 14.
- ⁵⁵ PMA-265, 14.
- ⁵⁶ PMA-265, 17.
- ⁵⁷ PMA-265, 17.
- ⁵⁸ Rick DeVore interview.
- ⁵⁹ Lieutenant Colonel Allee interview January 26, 2011.
- ⁶⁰ Rick DeVore interview.
- ⁶¹ Colonel "Crusoe" Robinson USMC, interview with author, January 19, 2011. Colonel Robinson is an F/A-18 pilot and commanded VMFAT-101 from February 2004 to January 2006 and has commanded MAG-31 since July 2009.
- ⁶² PMA-265, *F/A-18 & EA-18G Program SLAP SLEP Overview* PowerPoint Brief (Naval Air Systems Command F/A-18 Program Office, December 2010), 23.
- ⁶³ Major Douglas "Oedi" Glover USMC, interview with author, January 11, 2011. Major Glover is an F/A-18 WSO and was serving as the MAG-31 TMS Action Officer at the time of this interview. He currently is assigned to VMFA(AW)-533.
- ⁶⁴ Major Glover interview.
- ⁶⁵ Lieutenant Colonel Michael "Felix" Juenger USMC, interview with author, January 19, 2011. LtCol Juenger is an F/A-18 pilot currently assigned to the CNAL/CNAP F/A-18 Class Desk.
- ⁶⁶ Lieutenant Colonel Juenger interview.
- ⁶⁷ Colonel Robinson interview.
- ⁶⁸ Lieutenant Colonel Juenger interview.
- ⁶⁹ Lieutenant Colonel Juenger interview.
- ⁷⁰ Colonel Robinson interview.

⁷¹ Colonel Robinson interview.

⁷² Cox.

⁷³ Andrea Shalal-Esa, "Pentagon Delays F-35, Buys More Boeing Fighters," Reuters, January 6, 2011, <http://www.reuters.com/article/idUSTRE70561820110107?pageNumber=1> (accessed January 7, 2011).

⁷⁴ Colonel Robinson interview.

⁷⁵ Major Brian "Petie" Schenk USMC, interview with author, January 19, 2011.

⁷⁶ Major E. B. "Spicoli" Hipp USMC, interview with author, January 28, 2011. Major Hipp is an F/A-18 Pilot serving in the F/A-18 shop at Marine Aviation Weapons and Tactics Squadron 1.

⁷⁷ Major Dan "Freeze" Hingley USAF, email correspondence with author January 31, 2011. Major Hingley is stationed at AF/A5RC Fighter Requirements at the Pentagon.

⁷⁸ Major Dan "Freeze" Hingley USAF, brief delivered via email correspondence with author January 20, 2011.

⁷⁹ Major Dan "Freeze" Hingley USAF, email correspondence with author.

⁸⁰ Major Glover interview.

⁸¹ Andrea Shalal-Esa, "Pentagon Delays F-35, Buys More Boeing Fighters," Reuters, January 6, 2011, <http://www.reuters.com/article/idUSTRE70561820110107?pageNumber=1> (accessed January 7, 2011).

⁸² Lieutenant Colonel Allee interview.

⁸³ Deputy Commandant for Aviation, *FY11 Marine Aviation Plan*.

⁸⁴ Benjamin W. Spencer, "The Precious Sortie: The United States Air Force at the Intersection of Rising Energy Prices, an Aging Fleet, a Struggling Recapitalization Effort, and Stressed Defense Budgets," (Master's Thesis, Marine Corps University, 2009), 17.

⁸⁵ Lieutenant Colonel "Wiz" Mayer USMC, interview with author, January 10, 2011. Lieutenant Colonel Mayer commanded VMFA(AW)-242 from May 2007 to January 2009 and is currently a Faculty Advisor at the Marine Corps Command and Staff College.

Appendix A

Service Life Limiter matrix from the June 2004 Naval Message *F-18 Service Life Management Program* released by the Commander Naval Air Force and Deputy Commandant for Aviation.

2004

T/M/S	PRIMARY	SECONDARY	TERTIARY
F/A-18A/A+/B	Total Hours	FLE	Total Landings
F/A-18C	Cats/Traps	Total Hours	FLE
F/A-18D	FLE	Total Hours	Total Landings

Service Life Limiter matrix from the October 2007 Naval Message *F-18 Service Life Management Program* released by the Commander Naval Air Force and Deputy Commandant for Aviation.

2007

T/M/S	PRIMARY	SECONDARY	TERTIARY
F/A-18A/A+/B	Total Hours	FLE	Total Landings
F/A-18C	Total Hours	Traps	FLE
F/A-18D	FLE	Total Hours	Total Landings

Glossary

APB	Acquisition Program Baseline
APUC	Average Procurement Unit Cost
ARG	Amphibious Ready Group
ASR	Acquisition Strategy Report
BAI	Backup Aircraft Inventory
BUNO	Bureau Number
CAT	Catapult
CBR	Center Barrel Replacement
CNAF	Commander Naval Air Forces
CNAL	Commander Naval Air Atlantic
CNAP	Commander Naval Air Pacific
CPR	Consolidated Procurement Request
DC/Air	Deputy Commandant for Aviation
DLA	Defense Logistics Agency
DM	Decision Memoranda
DOC	Desired Operational Characteristics
DON	Department of the Navy
ECD	Estimated Completion Date
ECP	Engineering Change Proposal
FEM	Finite Element Models
FH	Flight Hours
FLE	Fatigue Life Extended
FRC	Fleet Readiness Center
FRP	Full Rate Production
FST	Flight Support Team
FUI	Fatigue Usage Index
FUSL	Full Up System Level
HFH	High Flight Hours
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
JIRD	Joint Initial Requirements Document
JPO	Joint Program Office
JSF	Joint Strike Fighter
LCAC	Landing Craft Air Cushioned
LMAC	Lockheed Martin Aerospace Corporation
LRIP	Low Rate Initial Production
MAG	Marine Aircraft Group
MAGTF	Marine Air Ground Task Force
MCAS	Marine Corps Air Station
MEU	Marine Expeditionary Unit
MS&A	Modeling Simulation and Analysis
NADEP	Naval Aviation Depot

NAE	Naval Aviation Enterprise
NAVAIR	Naval Air Systems Command
NAVICP	Naval Inventory Control Point
ORD	Operational Requirements Document
PD	Program Director
PEO	Program Executive Officer
PMAI	Primary Mission Aircraft Inventory
POM	Program Objective Memorandum
PUAC	Program Acquisition Unit Cost
PPBE	Planning Programming Budgeting & Execution
PRL	Partner Reprogramming Laboratory
RFO	Ready for Operations
ROM	Random Order of Magnitude
SCD	Ship Change Document
SDD	System Development and Demonstration
SAFE	Structural Appraisal of Fatigue Effects
SLAP	Service Life Assessment Plan
SLB	Service Life Bulletin
SLEP	Service Life Extension Program
SLMP	Service Life Management Plan
SRA	Systems Repairable Assembly
STOVL	Short Takeoff Vertical Landing
TAT	Turn Around Time
TMS	Type, Model, Series
T&R	Training and Readiness
TRAP	Arrested Landing
VMFAT	Marine Fixed Wing Fighter Attack Training Squadron
WRA	Weapons Replaceable Assembly

Bibliography

Boone, Jim and William F. Conroy III, CAPT Mark Darrah, Rick DeVore, CAPT Fred Hepler, and RADM Mark Skinner. "A Good Idea Comes to Fruition: The F/A-18 Center Barrel Replacement-Plus Program." *Defense AT&L*, September 1, 2010.

<http://www.thefreelibrary.com/A+good+idea+comes+to+fruition%3A+the+F%2FA-18+Center+Barrel...-a0240624309> (accessed 22 Jan 2011).

Commandant of the Marine Corps, "General James Amos' Statement on the Joint Strike Fighter," January 10, 2011, http://www.marines.mil/unit/hqmc/cmc/Documents/Gen%20Amos'%20Statement%20the%20Joint%20Strike%20Fighter%20110110_s.docx (accessed January 22, 2011).

Commander Naval Air Forces and Deputy Commandant for Aviation. *FA-18 Service Life Management Program*. Naval Message DTG R 011827Z Jun 04, June 1, 2004.

Commander Naval Air Forces and Deputy Commandant for Aviation. *FA-18 Service Life Management Program*. Naval Message DTG R 180417Z Oct 07, October 18, 2007.

Commander Naval Air Forces and Deputy Commandant for Aviation. *FA-18 Service Life Management Program Update*. Naval Message DTG R 272056Z Jan 09, January 27, 2009.

Congressional Research Service. *F-35 Lightning II Joint Strike Fighter (JSF) Program: Background, Status, and Issues*, by Christopher Bolkcom. Washington, DC, Congressional Research Service, Updated June 2, 2006.

Congressional Research Service. *F-35 Lightning II Joint Strike Fighter (JSF) Program: Background, Status, and Issues*, by Christopher Bolkcom. Washington, DC, Congressional Research Service, February 17, 2009.

Congressional Research Service. *Navy-Marine Corps Strike Fighter Shortfall: Background and Options for Congress*, by Christopher Bolkcom. Washington, DC, Congressional Research Service, April 10, 2009.

Cox, Bob. "Defense Secretary Proposes Cutting 124 F-35 Purchases." Fort Worth Star-Telegram, January 7, 2011, <http://ebird.osd.mil/cgi-bin/ebird/displaydata.pl?Requested=/ebfiles/e20110107798690.html> (accessed January 7, 2011).

Del Pizzo, Major C. W. *The Marine Corps STOVL Requirement*. Headquarters United States Marine Corps Aviation, APW-22, July 2010.

Department of the Navy. *Management of the Naval Aircraft Inventory*. OPNAV Instruction 5442.8, April 18, 1995.

Deputy Commandant for Aviation. *FY11 Marine Aviation Plan*. Headquarters United States Marine Corps, September 16, 2010.

Deputy Commandant for Aviation. *USMC Initial Operational Capability (IOC) Requirements*. Washington, DC: Headquarters United States Marine Corps, 1 March 2010.

F-35 Lightning II Program Office. *Selected Acquisition Report, F-35*. Arlington, Virginia: F-35 Lightning II Program Office, December 31, 2009.

Fries, Major T. C. *Why the USMC does not want F/A-18E/F Information Paper*. Headquarters United States Marine Corps Aviation, APW-21, 1 May 2007.

Headquarters United States Marine Corps Aviation, APP. *Why STOVL JSF version 7 PowerPoint Brief*. Headquarters United States Marine Corps, May 2010.

Headquarters United States Marine Corps Aviation, APW. *JSF MAGTF Keystone Brief PowerPoint Brief*. Headquarters United States Marine Corps, September 28, 2010.

Joint Strike Fighter Program Office. *Operational Requirements Document Change Notice 3*. Arlington, Virginia: Joint Strike Fighter Program Office, August 19, 2008.

Keeter, Hunter. "Navy, Marines Hold Course on SLEP Plan for F/A-18C/Ds." *Defense Daily*, February 21, 2001. <http://proquest.umi.com>.

Kreisher, Otto. "Aircraft Geriatrics" *Sea Power*, November 2006, 32. <http://proquest.umi.com>.

Majumdar, Dave. "AF Bomber Plans Hinge on Savings." *Defense News*, January 17, 2011. <http://ebird.osd.mil/cgi-bin/ebird/displaydata.pl?Requested=/ebfiles/e20110116800448.html>.

PMA-265. *F/A-18 & EA-18G Program SLAP SLEP Overview PowerPoint Brief*. Naval Air Systems Command F/A-18 Program Office, December 2010.

Shalal-Esa, Andrea Shalal-Esa. "Pentagon Delays F-35, Buys More Boeing Fighters." *Reuters*, January 6, 2011, <http://www.reuters.com/article/idUSTRE70561820110107?PageNumber=1> (accessed January 7, 2011).

Spencer, Benjamin W. "The Precious Sortie: The United States Air Force at the Intersection of Rising Energy Prices, an Aging Fleet, a Struggling Recapitalization Effort, and Stressed Defense Budgets." Master's Thesis, Marine Corps University, 2009.

Strategic Vision Group. *Marine Corps Vision & Strategy 2025*. U.S. Marine Corps, 2007. <http://www.quantico.usmc.mil/activities/?Section=SVG> (accessed August 15, 2010).

The Deputy Secretary of Defense, the Acting Secretary of the Air Force, and the Secretary of The Navy. *F-35 Lightning II Joint Strike Fighter (JSF) Program Charter*. August, 2008.

The Under Secretary of Defense, Acquisition, Technology and Logistics. *F-35 (Joint Strike Fighter) Lightning II Acquisitions Program Baseline Development Estimate Change 2*. Washington, DC: The Under Secretary of Defense, 30 March 2007.

Tirpak, John A. "End of the Raptor Option?" *Air Force Magazine*, September 2010.
<http://proquest.umi.com>.